maxima, five months (February and July to October) of moderate, and four (March to June) of high maxima. The months of high absolute humidity, July and August, are unfavorable to great intensity of insolation. The maxima of intensity are higher not only in the spring months, but also in September, and the absolute maximum of October is equal to that of July, but how different are the conditions of the lower atmosphere! In October the temperature is —6.7° C. and absolute humidity 2.2 mm.; in July the temperature is 21.3° C. and absolute humidity 10.6 mm.

During ten months out of twelve the absolute maxima were observed in the forenoon, a fact observed also elsewhere, apparently due to the fact that in the morning there is less aqueous vapor and generally also less dust or haze than in the afternoon.

At the end of this memoir the author gives in detail, for both stations, all the corresponding observations of radiation, cloud, and wind. The maximum radiation of each month, shown in the author's tables in bold-face type, is given in the accompanying Table 7, in plain figures, in column under head of "Maximum."

THE STUDY OF EVAPORATION.

By Prof. A. VOEIKOV. Dated St. Petersburg, December, 1907.

I was much interested in Professor Bigelow's paper "on the Salton Sea and evaporation."[1] Such another occasion is not to be expected soon, and the study intrusted to a man of the knowledge and ability of Professor Bigelow will be of immense benefit to science.

My present remarks apply to the comparison of the different formulas for evaporation in which the velocity of the wind is introduced. Professor Bigelow, by introducing the same values of temperature, humidity, and wind, finds that the results vary more than in the relation of 2:1 (Stelling 0.3495, Abassia 0.1337). I think the principal cause of the discrepancy between these empirical formulas is that the wind velocity was not observed at the same place where the evaporating basin or dish is situated, the anemometer being placed much higher, on the top of a building or on a tower.

The better the anemometers are placed for the needs of general meteorology—that is to say, the freer is the access of air and the less the retardation by friction, by so much the less will these wind velocities agree with those at the surface of the evaporation basin or dish. Then, if the evaporation is measured from a large tank or basin in the open air, the access of the wind will be freer than to small evaporation dishes placed, as they often are, in screens whose walls impede the access of air; but, on the other hand, the humidity of the air will be greater over the surface of a larger body of water, owing to the diffusion of the greater quantity of evaporated water.

The examples in Table 1 show a great discrepancy in the rate of evaporation, while the wind velocity, temperature, and humidity of the air are nearly the same. The evaporometer and its exposure in the screen were the same. The wind velocity is given approximately by Wild's wind vane, with heavy inclined pendulum plane.

TABLE 1.

Month.	Pinsk, 52° N., 26° W.				Vasilivichi, 52.3° N., 29.6° W.			
	Evaporation.	Temperature.	Relative humidity.	Vapor tension.	Evaporation.	Temperature.	Relative humidity.	Vapor tension.
1897.	*mm.*	°C.	%	*mm.*	*mm.*	°C.	%	*mm.*
June	71.4	18.7	63	3.5	96.6	18.3	69	2.3
July	65.2	19.9	76	3.0	94.7	20.1	73	2.8
August	65.8	19.4	73	3.1	96.5	19.0	74	3.1
September	34.5	12.9	81	2.3	52.9	12.9	80	2.3

[1] Monthly Weather Review for July, 1907.

Both places are in nearly the same latitude and distant by about 100 kilometers. At Pinsk there is a great expanse of river and marsh to the south and west. So the winds have freer access than at Vasilivichi, where forests impede them more. But at the screen where the evaporators are placed there is a rather thick growth of trees at Pinsk, while at Vasilivichi there is no growth of trees in the vicinity of the screen.

If empirical formulas were deduced from the observations at these two places, their coefficients would be different, those from the Pinsk observations would be such as to give smaller values for the same wind velocity, and those from the Vasilivichi observations greater values.

THE EVAPORATING POWER OF THE AIR AT THE NEW YORK BOTANICAL GARDEN.

By C. STUART GAGER. From the Journal of New York Botanical Garden, December, 1907.

In May, 1900, three meteorological stations were established in the garden.[1] Station 1, located in the herbaceous garden, was equipped with a standard rain gage, a thermograph, and a set of maximum and minimum thermometers. Station 2 was on a low ridge in the center of the hemlock forest, and station 3 in the central portion of the elevated plain of the fruticetum. The last two stations were equipped with thermographs only.

Late in September, 1904, these three stations were abandoned.[2] The catchment basin of the rain gage was installed on the roof of the museum building over the physiological laboratory, and, by means of a lead pipe extending down thru one of the supporting pillars, it was connected with the gage at the base of the pillar, inside the laboratory. The amount of precipitation recorded at the new station was found to be approximately the same as at the old one. The thermometers and thermographs were all transferred to a shelter house located within the experiment garden, near the propagating houses, on the eastern border of the garden.

Until June, 1907, the meteorological records at the garden include only the dates and amounts of precipitation, and the temperature of the air and that of the soil at two depths. The amount of precipitation, however, is not an index of the amount of water available to vegetation. Part of the meteoric water drains away thru the soil before it is used, while a portion of it evaporates from the surface of the soil into the air. It is the ratio between annual precipitation and evaporation that chiefly determines how nearly a given region approaches to either a swamp or a desert. In a swamp evaporation is less than precipitation, while in a desert the reverse is true.

It is a well-known fact that the rate of evaporation from a given area depends upon the relative humidity of the surrounding air. Relative humidity, in turn, varies with the temperature of the air and with the environment. Thus, for a given air temperature, the rate of evaporation from a given water surface will vary with the area of the surface and with the depth of the water, and the rate of evaporation from moist substances will be modified by the nature of the substance, and with the amount of moisture it contains. Thus, for example, water will evaporate more rapidly from one square foot of water surface than from two square feet, and more rapidly from one square foot with a depth of, say, one quarter of an inch, than it will from the same area over a depth of one foot. Also the same amount of water will evaporate at different rates from clay soil and from sand soil. Shrubbery and foliage tend in several ways to increase the relative humidity of the surrounding air, thus retarding evaporation.

The experiments described in this paper form part of a more extended investigation, inaugurated by Dr. Burton E. Livingston, of the Desert Botanical Laboratory, of the Carnegie Institution, at Tucson, Arizona. Evaporimeters of uni-

[1] Journal N. Y. Botanical Garden, vol. 1, p. 76, 1900.
[2] Journal N. Y. Botanical Garden, vol. 5, p. 211, 1904.

forn pattern, and standardized, have been distributed to some twenty-seven stations in the United States, ranging from Orono, Maine, on the east, to California on the west, and from Bozeman, Montana, on the north, to Gainesville, Florida, on the south, covering a wide range of altitude and of nearness to large bodies of water. Of these instruments, those received at the garden were Nos. 28, 30, and 34. It is hoped by means of the investigation to be able to establish a unit for measuring evaporation.

On the 6th of June, 1907, the evaporimeters were installed at three stations within the garden. These instruments consist of a pint fruit jar tightly corked with a cork stopper soaked in paraffine. Thru the stopper a glass tube extends from the bottom of the jar up and thru a second cork which tightly closes the opening into a porous clay thimble. The glass tube extends to the top of the thimble. For further protection against the entrance of water from without a paraffined piece of cloth was fitted tightly around the glass tube, and extended as a roof over the top of the fruit jar.

The jar was filled with distilled water up to a zero mark, and the porous thimble and the glass tube were also filled with distilled water. Each evaporimeter was sunk into the ground to the level of the top of the fruit jar. As evaporation took place from the surface of the thimble the water rose from the jar up thru the glass tube, thus keeping the thimble full and lowering the surface of the water in the jar. The rate of evaporation varied with the relative humidity of the surrounding air, and the amount was measured by carefully pouring more distilled water into the jar from a graduate until the water surface in the jar rose again to the zero mark. The amount of water necessary to accomplish this was the measure of the amount of evaporation for the given period.

Station 1 (evaporimeter No. 18) was west of the propagating houses on a dry, rocky knoll, covered with only a thin layer (one to two feet) of soil, and well drained. The instrument was shaded on all sides by tall saplings of red cedar and ailanthus, and numerous small herbaceous plants and vines such as smilax rotundifolia and ferns. The surface of the ground was covered with twigs and dead leaves. Station 2 (evaporimeter No. 30) was about fifty feet south of the stable near the eastern border of the garden. The ground is low, poorly drained, and marshy during the spring and other periods of wet weather. The instrument was surrounded with unmoved grassy sod, shaded by a tall sapling of alder on the west, and by tall shrubbery (forsythia, etc.) on the east. Station 3 (evaporimeter No. 34) was about six feet east of the instrument shelter in the experiment garden (fig. 37, omitted). On the north and west was sod, on the east and south cultivated ground, with evening primroses within two feet. The soil here is loamy and well drained.

The photograph (omitted) shows the above-ground portion of the evaporimeter near the tall fence post. Evaporation takes place only from the upper (whiter) part of the porous clay thimble. The top of the fruit jar which is sunk into the ground is covered by the paraffined cloth "roof," thru which the glass tube passes from the jar into the clay thimble.

The instruments were all standardized by Doctor Livingston, so that, after applying the correction for each instrument, the respective readings were strictly comparable, varying only with the external conditions that control evaporation. Readings taken every week on Monday morning from June 6 to October 14, 1907, and standardized by applying the necessary correction constant, are given in the following table.

It has been ascertained by Doctor Livingston that an evaporation of 6.05 cc. from the evaporimeters corresponds to 1 mm. of depth, or, in English units (since it is customary to measure precipitation in inches), 153.67 cc. of evaporation equals 1 inch of depth. For the purpose of ascertaining these data comparisons were made between the evaporation from the evaporimeters and from a chemical water bath, 25.6 inches in diameter, with the water standing 11 cm. deep when the surface is at zero on the scale. "It stands," writes Doctor Livingston, "with the water-surface level with the middle of the evaporimeters to be tested, and about two meters away from them. It is about 15 cm. from the ground to the water level. This level is about 5 mm. below the level of the dish at the beginning of a period, and the vessel is refilled once a day when the readings are made."

Week ending.	No. 28.	No. 30.	No. 34.	Week ending.	No. 28.	No. 30.	No. 34.
June 10, 1907	66	48	....	Aug. 19, 1907	126	89	188
June 17, 1907	77	48	129	Aug. 26, 1907	105	64	131
June 24, 1907	99	51	147	Sept. 2, 1907	118	85	128
July 1, 1907	60	29	106	Sept. 9, 1907	47	32	41
July 8, 1907	77	47	137	Sept. 16, 1907	74	41	85
July 15, 1907	99	55	129	Sept. 23, 1907	50	27	58
July 22, 1907	60	37	124	Sept. 30, 1907	50	....	35
July 29, 1907	130	56	185	Oct. 7, 1907	99	32	80
Aug. 5, 1907	98	37	132	Oct. 14, 1907	68	....	61
Aug. 12, 1907	82	46	142				

The total precipitation registered at the garden from June 10, 1907, to September 23, 1907, was 9.32 inches. This amount will be approximately the same for all three evaporimeter stations.[3] Therefore, taking the difference between the amount of precipitation in inches and the amount of evaporation from the evaporimeters in inches, we have:

For No. 28 (at the propagating house).... 9.32 in. — 8.47 in. = .85 in.
For No. 30 (at the stable)............... 9.32 in. — 4.84 in. = 4.48 in.
For No. 34 (at the experiment garden).... 9.32 in. — 12.10 in. = —21.42 in.

That is, at the propagating house precipitation was .85 inch in excess of the loss from the evaporimeter; at the swampy region, near the stable, 4.48 inches; while in the experiment garden during the same period the evaporating power of the air was 2.78 inches in excess of the precipitation recorded.

Now in should be kept in mind that the loss of water from the evaporimeters is not a measure of the amount of water lost by the soil thru evaporation, but is *only an index of the evaporating power of the air* for the given station. For the same locality the rate of evaporation from soil and from evaporimeter will materially differ, being less from soil and varying with its nature and condition, as well as with the surroundings above the soil surface.

The purpose of the above data, therefore, is not to give a measure of the amount of precipitation that remains in the soil, or that becomes available to the plants, but, as already emphasized, to give a measure of the evaporating power of the air in different localities. The above record, then, gives *numerical expression* of the fact that, of the three localities studied, the evaporating power of the air is greatest in the experiment garden, least at the swampy area near the stable, and intermediate on the elevated, shaded, and well drained rocky knoll.

RADIUM: ITS PROPERTIES, DISTRIBUTION, AND INFLUENCE ON THE ATMOSPHERE.

By W. W. STRONG. Dated Baltimore, Md., November 12, 1907.

THE RADIOACTIVITY OF RADIUM.

In communicating this memoir to the MONTHLY WEATHER REVIEW the author would remark that while the presence of the radium emanation in the air has not as yet led to any fundamental meteorological discoveries, yet I think it may clear up many points in atmospheric electricity. I believe that the ionization produced by the α particles of the emanation and "radium C" plays a considerable rôle in the formation of nuclei for raindrops to condense upon.

Ramsay discovered small quantities of helium, argon, and neon in the air. These may be disintegration products of radium also.

[3] This may be far from true; there should be a gage near and at the level of each evaporimeter.—EDITOR.